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REPORT ON WORKSHOP ON THE DEVELOPMENT OF THE BUILDING MATERIALS AND CONSTRUCTION INDUSTRIES IN AFRICA BASED ON INDIAN EXPERIENCES

ORGANIZED BY

ECONOMIC COMMISSION FOR AFRICA IN COLLABORATION WITH THE INDIAN GOVERNMENT

Held in New Delhi, India
from 8 - 12 June 1981

LC/NAIROBI

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Background

1. The construction and building materials industries are in themselves an important factor of national economic growth because of their interindustrial linkages with a number of national social and economic activities - more specifically human settlements - and their potential for employment generation on a massive scale. This industrial sector comprises two interdependent elements (a) building materials in the strict sense and (b) construction and public works, which are the major market for building materials (housing and building construction and civil engineering). Although the sector is of primary importance for the general development of Africa its growth has been middling. In the two sectors mentioned earlier, production or implementation costs have increased substantially, and needs are most often met through imports which involve heavy foreign exchange spending. For example, Africa's net imports of building materials for the years 1976 and 1977 amounted to $US 3,020 and $US 3,680 million respectively, while total spending on construction amounted to approximately $US 10 billion for each of the two years. Judging from this trend and allowing for progressive improvement and modernization of peri-urban and rural construction in the form of better design and improved building materials and techniques, the rate of demand for construction materials and services in the future will doubtless exceed what it has been to date. It is forecast on this basis that by the year 2000, total construction spending will be in the region of $US 30 billion.

2. Although the basic raw materials required are available in the region as a whole, the major obstacles to the integrated development of the sector have been the uneven distribution of resources, inadequate systems of production, standardization and marketing in addition to the lack of information, research, technical and qualified manpower services. Such basic resources as raw materials and manpower are largely untapped, while at the same time demand for buildings and construction services are growing rapidly. Various studies conducted by ECA have indicated that these problems could be solved only within the context of a unified approach and strategy and of a global programme embracing not only national potentials and priorities but also the options open at the subregional level to groups of countries prepared to undertake joint operations in specific sectors of development.

3. The Conference of African Ministers of Industry, the Follow-up Committee on Industrialization in Africa and the Intergovernmental Regional Committee on Human Settlements have considered various possibilities, defined high-priority activities for developing the sector and urged the Economic Commission for Africa to prepare a detailed development programme in collaboration with appropriate United Nations agencies, with the aim of enabling African countries to achieve self-sufficiency in the sector by the year 2000.

4. In accordance with these terms of reference, ECA , in consultations with UNIDO, UNCHS (HABITAT), UNEP and OAU, prepared an integrated development programme for the building materials and construction industries sector which began to be implemented in 1978. The programme has the following immediate objectives:

(i) To assist States members of the Commission in developing, improving and strengthening their policies, strategies and their operational instruments so that they can define, co-ordinate and implement their building materials and construction industries development programmes more effectively;

(ii) To assist African countries in establishing new building material production facilities and to improve those already existing through the selection of appropriate technologies, respect for the principle of self-sufficiency in basic raw materials and the scaling of the size of industrial installations to that of the local markets to be supplied within a reasonable radius. This would take into account considerations relating to transport, better use of installed capacities and a definition of quality standards likely to reduce costs and promote the development of intra-African trade in raw materials, semi-finished and finished products;

(iii) To assist African Governments in further streamlining construction systems and services in order to adapt them more and more to local conditions and needs and thereby reduce costs;

(iv) To assist member States in setting up African research, information and documentation services in the field of building materials and construction and in strengthening those services that already exist with a view to developing new, rational and inexpensive techniques and modernizing current and traditional methods.

5. This framework for the building materials and construction industries development programme covers, at the national, subregional and regional levels the tasks defined by African Governments themselves in the form of recommendations adopted at various meetings of African experts that ECA organized in 1978, 1979 and 1980. One of the major operations designed as a follow up to those recommendations concerns seeking ways and means of encouraging the practical sharing of experience in essential construction materials production and utilization between African specialists and their counterparts from developing countries of other regions. It is worth noting in this context that developing countries of other regions that have experienced difficulties similar to those being faced by African countries in the building materials and construction sector have succeeded, in some areas, in designing new policies and innovative strategies for the organization and development of inexpensive technologies and the rational use of available manpower. This is true for example of the design, establishment and operation of large, medium and small-scale building materials production units tailored to particular situations. It is also true of the various institutional machineries set up to organize the required activities on a co-ordinated and unified basis.

6. In collaboration with the Government of India, the Economic Commission for Africa organized a study tour in India followed by a technical workshop for a team of 12 African experts on the building materials and construction industries drawn from Burundi, Congo, Ethiopia, Ghana, Guinea, Madagascar, Nigeria, Sudan, Tunisia, the United Republic of Cameroon and the United Republic of Tanzania during the period 30 April to 18 June, 1981. The objectives of the study tour were to assist African countries, through their experts in the building materials and construction industries, to learn from the experience that India has acquired in:

(i) The establishment of national capabilities in the preparation, organization and implementation of projects relating to the production of building materials and the establishment of construction services and systems matching African conditions and markets in addition to the strengthening of existing national capabilities;

(ii) The promotion of indigenous building materials production yielding maximum advantage from local raw materials and making the best use of local manpower in the production and utilization of building materials

(iii) The development of adequate systems that can provide the necessary building materials anywhere at any time for the implementation of national construction programmes prepared in line with economic and social development plan objectives.

7. The study tour which took the African experts to New Delhi, Roorkee, Dehradun, Satna, Madras, Tiruchirapalli and Bangalore, afforded them the opportunity to visit and hold discussions with Indian experts at building materials production plants employing varying scales of technologies, building and building materials research institutes, housing development organizations and promotional organizations in the building materials and construction industries sector. The experts were also able to meet with officials of the All India Brick and Tile Federation and the Lime Manufacturers Association of India.

Objectives of the workshop

8. The workshop, which was organized immediately following the above study tour of the African experts, was directed towards achieving the following objectives:

(i) To provide a forum for the African experts to exchange ideas and experiences with their Indian counterparts in the light of their observations on the various visits and discussions undertaken during the study tour, so as to be able to concretize their views about the Indian experience;

(ii) To identify in what specific ways African countries could take advantage of Indian experiences in the promotion and development of the building materials and construction industries, giving due attention to the specific nature of available resources in the African countries.

II. ORGANIZATION OF THE WORKSHOP

Date and venue of the workshop

9. The workshop which was organized by the United Nations Economic Commission for Africa in collaboration with Indian organizations and experts, was held in New Delhi, India from 3 June to 12 June, 1981.

Participation

10. The workshop was attended by twelve African experts on building materials and construction industries drawn from Burundi, Congo, Ethiopia, Ghana, Guinea, Madagascar, Nigeria, Sudan, Tunisia, the United Republic of Cameroun and the United Republic of Tanzania.

11. Also in attendance were experts from the National Buildings Organization (NBO), the Central Building Research Institute (CBRI), the Cement Research Institute (CRI), the Forest Research Institute (FRI), Delhi Development Authority (DDA), the Brick and Tile Manufacturers Federation and the Lime Manufacturers Association, all from India.

Opening of the workshop

12. Mr Apéti Dansou, Co-ordinator of the ECA Building Materials and Construction Industries Development Programme read an address on behalf of the Executive Secretary of the United Nations Economic Commission for Africa who was unable to be present at the workshop, in which he extended a warm welcome to the participants and expressed deep gratitude to the National Buildings Organization, the Central Building Research Institute, the Cement Research Institute of India and all the Indian organizations and individuals without whose valued co-operation and assistance it would not have been possible to organize the workshop.

13. He recalled that the workshop was the culmination of a very important phase of the Building Materials and Construction Industries Development Programme launched in 1970 by the Economic Commission for Africa in co-operation with African regional and international organizations and with African countries themselves. This Programme has the primary objective of assisting African countries to achieve self sufficiency in the building materials and construction sector speedily on the basis of self-sustained and self-reliant actions. The programme rightly emphasizes the importance of studying the successful experiences of other developing countries, particularly India, in the rapid promotion of a strong, indigenous and self-reliant building materials and construction industries sector in order to determine how these experiences could be adapted to suit the prevailing conditions in the countries of the African region. In this connexion, the Executive Secretary expressed his gratitude to the Government of India for appreciating Africa's developmental needs and giving financial and technical assistance which had made it possible to organize a study tour and workshop in India for a group of African experts. He expressed the hope that the workshop would prove to be a forum for practical discussions and exchange of views which would lead to concrete ideas for future actions.

14. The workshop was then declared open by Mr. Mukharji, Secretary of the Ministry of Works and Housing who in his speech, declared his appreciation of the initiative taken by the United Nations Economic Commission for Africa in deputing a team of specialists from different African countries on an eight week study tour to India to acquaint themselves and to have first hand information about technical developments in the field of building and housing industry in India. He highlighted some of the measures taken by the Government of India to tackle the colossal problem of housing and emphasized the high priority that had been accorded to housing for the economically weaker section and low income groups of the population, the augmentation of building materials production particularly by greater utilization of local raw material resources as well as industrial and agricultural wastes, provision of finance to State governments for undertaking large scale housing projects and promotion of research and development in the field of housing.

15. The Secretary expressed the hope that the initiative taken by ECA would pave the way for future collaboration between India and African countries for tackling the problem of housing and building expeditiously, and assured the experts of the willingness of the Government of India to provide technical assistance in specific fields as might be identified by them during the workshop.

Officers of the workshop

16. The deliberations of the workshop were carried out under the joint-chairmanship of Mr. Apéti Dansou, Co-ordinator of the ECA Building Materials and Construction Industries Development Programme and Mr. G.C. Mathur, Director of the National Buildings Organization, New Delhi. The African experts, among them, served as rapporteurs for the various sessions of the workshop.

III ACCOUNT OF PROCEEDINGS OF THE WORKSHOP

Production and utilization of clay bricks, roofing tiles and other masonry blocks (Session I)

a) Presentation of paper

17. Dr. A.V.Rao, Joint Director of the National Buildings Organization presented a paper entitled "Production of bricks, roofing tiles and other masonry blocks" which is summarized as follows:

18. Over 40 billion bricks are produced annually in India by the hand moulding method by 10,000 to 15,000 small units throughout the country. The digging, processing of clay, moulding and firing operations are carried out manually. One-third of the brick production is in rural areas by clamp kilns using wood, cinder and whatever agricultural wastes are locally available. The quality of bricks produced in clamps is poor but these bricks possess sufficient strength for construction of single storeyed houses. In urban areas bricks are produced by Pulls Trench Kilns using slack coal. The capacity of production varies from 2-5 million bricks per year with a labour force of 100-150. The investment cost is US$ 0.1 million per 10 million bricks. The major brick producing areas are in the Indo-Gangetic plains: U.P., Delhi, Punjab, West Bengal and Bihar where the soil available is most suitable for brick making by hand moulding methods. The bricks are produced at low cost and have strength between 70 and 100 kg/cm2. The type of soils in M.P., Andhra Pradesh, Karnataka, Maharashtra are of either the black cotton or Murram type which are not suitable for producing good quality bricks by hand moulding methods. Bricks produced in these areas are of strength 20-40 kg/cm2 but these soils could be improved considerably by processing to produce bricks of strength 100-150 kg/cm2.

19. Nine mechanized brick plants of total capacity 200 million bricks per year have been established both in the public and private sectors. Most of them produce solid bricks of strength 150-200 kg/cm2. The cost of production in the mechanized units is almost double that in the labour intensive units. Bricks produced in the mechanized plants are therefore not able to compete with hand moulded bricks. To improve the quality of bricks by hand moulding methods, NBO and CBRI have introduced simple moulding machines and improved kilns. NBO has set up a Demonstration-cum-Production unit at Chandigarh where a soft mud brick moulding machine has been installed together with a traditional Bull Trench kiln. The bricks produced are better in quality and have twice the strength of local bricks. This improvement is achieved with a cost increase of US$ 1 per thousand bricks. The investment and labour requirements for various types of brick production units are given in the paper.

20. There are over 600 units in India that manufacture burnt clay roofing tiles (Mangalore pattern) most of them are concentrated on the West Coast - Kerala, Karnataka, Tamilnadu and Andhra Pradesh, where suitable plastic clays are available. These plants are also labour intensive but are mechanized with regard to processing of clay and moulding of tiles; they also use better kilns - hoffmans, with coal or wood as fuel. The investment for a plant of 5 million tiles per year is about US$ 70,000. The paper also gives information about production of substitute materials for bricks in India such as sand - lime bricks, cellular concrete, cement concrete blocks, laterite blocks and soil stabilized bricks.

b) Discussions

21. During the discussions which followed the presentation the experts raised questions relating to the energy requirements for the production of a sand - cement block wall and a burnt brick wall of the same dimensions, properties of brick making clays, fuels for burning bricks and the acceptability of brick constructions.

22. In answer to questions by some African experts, the representative of the All India Brick and Tile Federation expressed the willingness of the federation to depute its experts to assist any African country desiring to set up brick plants based on the technologies developed in India. The federation would also be able to provide facilities for training African technicians in brick making techniques in India. He stated further that it had become necessary to introduce mechanization gradually in the brick making process, particularly in relation to brick moulding, because of an increasing shortage of skilled moulders in India. Complete mechanization has not been found to be economical at this time because of the high competitiveness of the labour intensive brick production units. With regard to financing of the brick industry, the representative declared that the primary source is the commercial banks. Financial assistance has also been provided by HUDCO for the operations of some small brick enterprises.

23. It was generally agreed that burnt bricks produced at reasonable cost in African countries could become a viable alternative for currently used conventional walling materials, particularly cement and cement products. Standardization of the bricks as well as their promotion by government agencies would be important factors to consider in this respect. The bulls trench kiln which is commonly used for brick production in India could be considered by African countries which have coal. The labour capital mix for brick plants would however require careful study since labour costs in the majority of African countries are higher than those in India. In rural areas where high strength bricks are not required, clamp kilns using wood or agricultural wastes as fuel could be established. The production of clay roofing tiles could also be promoted in areas where suitable plastic clays are available.

Small-scale cement production (Session III)

a) Presentation of paper

24. The Acting Director General of the Cement Research Institute of India, Dr. S.K. Chopra introduced his paper entitled "Cement production in small-scale" which is summarized as follows:

25. Today the trend in the world of cement is to go in for larger and larger plants, mainly with a view to reaping the benefits of the scale effect. But the large cement plants are not the answer for all situations. The case for developing and establishing mini-cement plants in developing countries has arisen from the logistic governing the exploitation of a large number of small limestone deposits dispersed at various locations and the versatility of such plants to match the limited availability of power, water and other inputs. Further, the mini-cement plants in meeting the demands of a local captive market, reduce the strain on the national transportation infrastructure, make possible the participation of local smaller entrepreneurs and help to uplift the local economy. The choice of technology for the production of cement in small scale would have to be based on techno-economic considerations. The vertical shaft kiln technology offers a number of advantages. The paper discussed the various choices available for production of cement in small scale, their relative techno-economic features, the Indian experience in developing

a technology appropriate to conditions obtaining in that country, the versatility of the technology developed by the Cement Research Institute to suit any given set of conditions, the investment on different capacities based on different available technologies and the related cost of production.

26. The assessment of the reserves of limestone, both in qualitative and quantitative terms, is a pre-requisite for considering the investment decision for setting up a cement unit. An inferred reserve of the order of 1.35 million tonnes with lime content within the range of 44 to 52 % is required for setting up a 50 tonne per day plant. The limit of volatile content in the fuel, which is an integral part of the raw-mix for Vertical Shaft kiln technology, is one of the essential parameters which require to be ascertained. Fuel with volatile matter of 10 % would be ideal. However, ordinary coal with volatile content of 22 % could also be used.

27. The Cement Research Insitute offers the technology for small scale production of cement to interested entrepreneurs by way of technical support and consultancy comprising raw material evaluation, feasibility studies for setting up such plants, project engineering, erection and commissioning with the required guarantees, laboratory training at its main laboratories at Ballabgarh and in-plant training at its 20 tpd mini-cement plant at Muduvathur as part of a total package of know-how. Turn-key services are also offered by CRI through the machinery manufacturers identified by the Institute.

28. Dr. Chopra also introduced a short paper entitled "CRI technology for the manufacture of rice husk ash masonry cement". The technology developed by the Cement Research Institute aims at the utilization of the huge quantities of paddy waste (rice hulls) available from the hulling of rice either in the field or at the mills and producing a rural binder material. The paper gives a brief profile of the essential features of this technology including process technology, raw materials (rice husk, limestones, modifiers and coal), plant and machinery, minimum economic size, product evaluation and socio-economic benefits of using the technolgoy etc. A 2 tonnes per day production-cum-demonstration unit based on the CRI technology was commissioned in June 1980 at Gangoh, Saharampur District of U.P. Consumer acceptability has been very encouraging and the product is being used extensively for masonry purposes.

b) Discussions

29. An important point that was raised during the discussion following the presentation related to the use of other sources of energy, like oil and electric power, for production of cement in mini-cement plants based on the vertical shaft technology, instead of the low-volatile coal that is presently being used. The speaker explained that the technology for using these sources of energy had not been developed in India since coal had been found to be, and remained, the cheapest source of energy. However, the fusion technology which uses electricity as energy, and is available in other countries, could be used particularly for cement production from limestones containing high proportions of magnesium. Other questions that were discussed concerned:

(i) The criteria for establishing mini-cement plants as opposed to expanding existing cement plants;

(ii) The economics of setting up mini-cement plants vis-a-vis large-scale plants;

(iii) The technology for selective mining of limestone deposits in which high calcium limestones are interbedded with high magnesian limestones;

(iv) The capabilities of the Cement Research Institute of India regarding technical assistance for the establishment of mini-ciment plants in other countries outside India

(v) Aspects of the CRI technology for production of rice husk as masonry cement including the optimum plant size of production units.

30. In conclusion it was agreed that

(i) The mini-cement plant technology developed by the Cement Research Institute deserved consideration by African countries, taking cognizance of the fact that some research was needed on the feasibility of using sources of energy other than coal which was not readily available in the majority of African countries; in this connexion the assistance of the Indian Cement Research Institute would be greatly appreciated

(ii) The setting up of mini-cement plants should be preceded by comprehensive techno-economic and social studies to ensure sound decision-making; for isolated locations social considerations could be a major factor to take into account.

(iii) African countries should, when necessary encourage split location methods of cement production whereby clinker produced in large clinker plants could be ground in grinding plants set up near the points of consumption in this regard subregional co-operation was stressed.

(iv) The use of pozzolanas in existing cement plants as a means of improving their profitability and increasing availability of cement for construction (by making pozzolana-cements) should be considered by African countries

(v) The utilization of rice husk to produce rice husk ash masonry cement on the basis of technology developed in India should be considered by African countries where rice is produced and rice husk is available as a waste material.

Research and development in the field of housing (Session IV)

a) Presentation of paper

31. The director of the Central Building Research Institute (CBRI) at Roorkee, Prof. Dinesh Mohan introduced his paper entitled "Research and Development in the Housing and Building Material Industry" which is summarized as follows:

32. Housing has recently been receiving the attention of the Indian Government through its welfare policies. Housing construction, however, is not rapidly catching up with the demand largely because of an unorganized building sector and low investment returns. On the other hand, an affinity to traditional ways and the lack of an innovative spirit are responsible for the slower adoption of new developments. However, some of the new processes and products developed by research institutes have been found to have good potential and are in use in different parts of the country. The basic aim of these researches has been to achieve economies of cost and time by upgrading conventional materials, utilizing agro-industrial wastes, rationalizing structural design and introducing partial prefabrication through standardization in construction systems.

33. However, innovations in themselves are not enough to solve the problems of the building industry which must be revamped to respond to the changing socio-cultural environment. Research and Development in this field is therefore necessary and is perhaps the only hope of providing houses within the means of the common man. Prof. Mohan explained, with the help of slides, some of the achievements of his institute in the development of building materials, building techniques and construction systems.

b) Discussions

34. The presentation was followed by a lively discussion during which questions posed by the African experts were dealt with by Prof. Mohan and some of his colleagues from the Central Building Research Institute. These questions concerned mainly the following areas:

(i) The need to influence decision making at the governmental level in favour of the promotion of research and development and the application of innovations in the field of housing by involving more technical personnel in the decision making apparatus;

(ii) The complex nature of the subject of application of research findings and how existing problems could be resolved

(iii) The need for innovative approaches concerning dissemination of information on new processes and techniques.

35. In conclusion it was agreed that:

(i) There was need for governments to increase the resources for research and development and to ensure maximum utilization of the results of research through appropriate institutional mechanisms

(ii) Engineers, architects and other technical personnel should aspire to positions in the governmental decision-making apparatus so as to be able to provide guidance that would lead to more positive decisions favourable to the development of research and the application of research findings

(iii) In order to remove bottlenecks that hinder the ready application of research findings steps should be taken to educate engineers, architects and other technicians on new building techniques and systems through seminars and courses and also at the universities; organize training programmes for middle level technicians and artisans; increase resources available for disseminatio particularly for the establishment of pilot/demonstration projects;

(iv) Research had contributed significantly to the use of improved building materials in the rural areas of India and that African countries could benefit from some of the Indian experiences in this field.

Processing and utilization of agricultural and industrial wastes as building materials (Session V)

a) Presentation of paper

36. The main paper for this session entitled "Processing and Utilization of Industrial and Agricultural Wastes" was presented by Dr. Mohan Rai, Scientist Co-ordinator and

Read, Building Materials Division (CBRI). A summary of his paper is given in the following paragraphs.

37. The processing and utilization of industrial and agricultural wastes in the development of new building materials is being given top priority in the programmes of building research institutes all over the world. This is important both from the point of view of achieving maximum disposal of the wastes and conservation of conventional and scarce resources and materials. Research and Development in the Central Building Research Institute have shown that granulated blast furnace slags containing high percentages of manganese oxides, higherto considered deleterious, and phosphorypsum another waste from fertilizer plants, could form very inexpensive sources of raw materials for the manufacture of slag cements and building plaster and plaster boards.

38. Slags and waste lime sludges from sugar, paper and carbide-acetylene gas plants can be utilized in making masonry cements. Whereas lime sludges and rice husk burnt together produce a low cost cementing material, the product of burning clay and rice husk makes a fine pozzolana. A reactive lime pozzolana composition has also been developed using waste lime from lime kilns and industrial ashes. Red mud waste from aluminium industries, water works silts and slate wastes have been found useful for making good quality bricks and light weight aggregates. Extensive researches on the utilization of thermal power station fly ash have led to the recommendations of its use as a part replacement of portland cement in in-situ concrete, in mortars and plaster, and in making sintered light weight aggregate. Several mining wastes such as those from beneficiation of iron, zinc, copper and gold ores have been found suitable for making sand-lime bricks, cellular concrete or lime stabilized bricks. Laterite wastes have likewise been used for making building bricks and blocks.

39. Agro-industrial wastes such as rice husk, coir fibres, coconut husk and pith, rice straw and ground nut husk have been used in developing cement-bonded walling boards and corrugated roofing sheets, with additional advantages of toughness and better thermal insulation. Wastes from forests and timber processing industries in the form of branches, saw dust, tannings etc. have also been used for burning bricks in the usual Bull's kilns.

40. The paper deals with the detailed account of the above possibilities and related economics in augmenting the supplies of essential building materials.

b) Discussions

41. The discussions which followed the presentation centred around the rational utilization of agro-wastes as fuel and as raw materials for building materials production, the assessment of the durability of building materials and products obtained from agricultural and industrial wastes and the progress made in India in the introduction of the new developed materials into the building industry. It was explained that India has a long tradition in the use of agro-wastes like rice husk, as a source of energy for the production of bricks and tiles. The CBRI has conducted some firing operations in Bulls trench kilns in which rice husk was the principal fuel. The use of agro-wastes as fuel or as raw material for production of building materials and components is essentially a matter of relative costs and benefits.

42. Although there is a great potential for the manufacture of building materials from industrial, mineral and agricultural wastes, Dr. Mohan Rai admitted that only a few processes out of the large number investigated have so far been translated into industrial production in India.

43. Answering other questions regarding Research and Development work at CBRI, he mentioned that even though the institute has done significant studies on the production of sandlime bricks, commercial production and large-scale use of these bricks in India is not possible at present because of the availability of cheaper burnt bricks. Sandlime bricks however require little energy for their production and do not need to be plastered when used in building. CBRI has also done research which permits the use of dolomitic limestones containing up to 8 per cent magnesium oxide to be used for the production of cement.

44. In conclusion it was agreed that:

(i) There was an urgent need for comprehensive surveys, in African countries, of the present status and use of various waste materials, as well as their evaluation and standardization methods for their systematic collection and processing should also be established;

(ii) There is need for well-equipped materials research laboratories to facilitate the determination of the properties of waste materials and the assessment of their suitability for conversion into building materials;

(iii) The long-term environmental effects of waste utilization, for example in the case of cynide sludge orsulphur, should be given high priority in research on waste materials.

Production and utilization of lime and pozzolana (Session VI)

a) Presentation of paper

45. The main paper for the session entitled 'Production and utilization of lime and pozzolana in India' was presented by Dr. A.V.P. Rao, Joint Director of the National Buildings Organization. A summary of the paper is given below:

46. Lime, alone or in combination with clay pozzolana, was the main binding material used for construction in India till 1930. After the introduction of portland cement, lime went into oblivion in urban areas due to its variation in quality and inherent defects such as slow setting, laborious process of preparation of mortar and poor keeping qualities. An improved process of manufacture of lime and its controlled hydration and also of clay pozzolana have helped to overcome these defects. Due to low investment ($ 15 per tonne) required, smaller plants (20-50 tonnes per day capacity) which could be set up economically at a number of places and short gestation periods (8-12 months) and better properties of lime mortar as compared to cement, N.B.O. and other organizations have taken up the promotion, production and use of hydrated lime and clay pozzolana as a replacement of cement in some of the building items such as mortars and plasters. NBO has set up a demonstration-cum-training unit and has also organized seminars and training courses in collaboration with industry.

47. The lime industry in India exists in three groups: tiny and cottage scale: ½-2 tonnes per day capacity in rural areas; small and medium scale: 10-50 tonnes per day where large limestone deposits exist and large scale plants set up by the chemical industry for their own use. Some of the medium scale units have set up hydrators similar to the N.B.O. plant for production of standard quality hydrated lime. Investment and man-power requirements of lime plants of various capacities are given in the paper.

48. Several processes have been developed for production of clay pozzolana by the Central Road Research Institute, Gujarat Engineering Research Institute, Nasik and N.B.O. N.B.O. has set up a fluidized bed calciner for the same purpose. Other types of pozzolana such as flyash and rice husk ash have been used to a limited extent.

49. The optimum economic unit for production of hydrated lime in India by mixed feed shaft kilns is 50 tonnes per day and for clay pozzolana, 15 tonnes per day. For such plants the type of raw materials, plant and equipment required, the factors that need to be considered for location of factory, the process of manufacture, quality control and the cost of production have been dealt with in detail. Ready made lime pozzolana mixes have been developed. Various types of mortar using lime and lime pozzolana mixes have been tested and found to possess strengths comparable to conventional cement mortars used in building construction and are economical. African countries could consider setting up demonstration-cum-training plants and small capacity plants in rural areas and medium sized plants with hydrators.

b) Discussions

50. The question of fuel for the production of building materials was again raised during the discussions that followed the presentation. The views of the speaker and other Indian experts were sought on the possibilities that existed for the modification of kilns being used in India to use fuels other than coal. It was explained that some of the kilns in use could, with only small modifications, be operated using firewood and oil as fuel. The method of feeding the raw materials may require changes in some cases. It was apparent however that each country would have to make the necessary computations to determine the most economical fuels to use in given situations.

51. As regards the optimum size of plants for the production of lime, which has been established to be 20-50 tonnes per day under Indian conditions, it was stressed that the Indian technology could still be used for situations where larger production capacities were required through the setting up of a battery of kilns. The machinery developed in India for lime plants were not very sophisticated and could progressively be manufactured in African countries themselves. Other questions discussed concerned increased production and utilization of pozzolana even in countries where no naturally occurring pozzolana was available. In this connexion use of rice husk ash as a pozzolana was emphasized. Studies would also have to be undertaken to identify other sources of pozzolana.

52. In answer to questions raised by some of the African experts, the representative of the Lime Manufacturers Association of India outlined the areas in which the association could offer technical assistance to African countries. The association can undertake the whole range of activities from feasibility studies, plant design, supply of machinery to erection and start up of the plant. The training of personnel to operate lime plants could also be undertaken in India as well as on-the-job in the countries concerned.

53. In conclusion, it was evident that lime and lime-pozzolana can be produced using unsophisticated methods and that African countries should examine their available raw materials for this purpose and take the steps necessary for the production of these materials using technologies suitable for various levels of demand in different locations in the countries. The experience of India in this regard could be adopted with modifications, as required.

Production and utilization of wood and wood-based products (Session VII)

a) Presentation of paper

54. The Director of Forest Products Research at the Forest Research Institute, Dr. S.R.D. Guha's paper entitled "Utilization of Timber and allied products in building industry" was presented on his behalf by Dr. H.C. Tewari also of FRI. The paper emphasizes the need for introducing scientific processing procedures, secondary species of timbers, panel products re-constituted from inferior species, rational selection of species, grading of timber, and low cost timber engineering designs in the building construction industry, both in urban and rural sectors in developing countries. The importance of adopting these scientific practices for building use has been recognized, particularly for the developing countries having a very sizeable rural section of the population which uses a larger component of timber and other forest-based materials like bamboo, thatch grass, etc. in housing and buildings. The socio-economic and organizational constraints on the building construction industry in the developing countries come in the way of adoption of these scientific processes.

55. It is recognized that some of the developing countries already have a fairly good technological base for introducing these practices. But the constraints mentioned above suggest that national governments in these countries will have to come forward in a big way to set up centres for producing, stocking and distributing processed timber and prefabricated timber components for the consumer at large and also to propagate the advantages of scientifically constructed timber structures by setting up model houses for demonstration. The paper also gives information pertaining to the choice of species for constructional purposes, including strength classification, grading of timber, wood working properties, seasoning and preservation characteristics, methods for seasoning and preservative treatment; timber engineering designs and panel products, collected by the Forest Research Institute after extensive tests on a large number of species.

b) Discussions

56. The discussion which followed the presentation of the paper related to

(i) The need to encourage the use of treated timber and forest-based products;

(ii) Measures to be adopted for the conservation of forestry resources;

(iii) The need to popularize the use of composite panel products as a means of reducing wastage in the use of timber and

(iv) the promotion of the use of wood waste for the production of building materials.

57. In India, as a result of the various actions taken by the government, including familiarizing major construction companies, engineers and architects with the benefits of using processed and treated wood through seminars and symposia, setting up treatment plants for secondary species of wood, constructing demonstration houses in forest zones and modifying the schedule of rates of the Central Public Works Departments, State Public Works Departments and State Housing Boards to include the use of treated timber, some progress has been achieved in encouraging the use of secondary wood species in construction.

58. In view of the fast rate at which forests in African countries are being depleted, it was stressed during the discussions that major afforestation and forest protection programmes should be launched in all countries. Alternative source of fuel for domestic use should be developed to reduce the use of firewood for this purpose, especially in the rural areas. Strong support was expressed for the implementation of national programmes for the scientific management of forest products utilization to ensure a rational use of available forest resources. In this connexion it was agreed that:

(i) It is necessary to undertake studies on the identification of the available timbers so that the wealth of information available worldwide on seasoning and preservation could be advantageously used;

(ii) In order to ensure maximum service life of timbers used in construction, adequate measures should be taken to discourage the use of untreated wood, at the same time encouraging the setting up of timber treatment plants to ensure the availability of good quality wood for construction purposes;

(iii) Courses in timber technology should be included in the training programmes for engineers and architects;

(iv) Standardization of wood and wood-based products should be given serious attention so as to promote more efficient use of these materials in construction.

Rural housing (Session VIII)

a) Presentation of paper

59. The main paper for this session entitled "Rural Housing - Technological Advancement in Rural Construction" was introduced by Dr. G.C. Mathur, Director of the National Buildings Organization (NBO). The paper is summarized below:

60. More than 80 per cent of the population in India live in rural settlements. At the beginning of 1981 the housing shortage in rural areas was estimated to be of the order of 16.5 million dwelling units. Research and development work has been undertaken by the National Buildings Organization and its 10 Regional Rural Housing Centres in promoting improved use of local materials and construction of more durable and liveable rural houses at lowest possible cost. Research in housing including social and economic aspects of housing has been undertaken for improving rural housing conditions. Training courses for engineers, block development officers and Panchayat Raj officers have been conducted on regular basis. Extension of results of research has been extensively made, particularly by putting up clusters of low cost demonstration houses in selected villages in different regions in the country. The important activities of National Buildings Organization in the field of rural housing have been described in the paper.

b) Discussions

61. During the lively discussions which followed the presentation of the paper, Dr. Mathur explained that the National Buildings Organization deals with problems of housing both in urban and rural areas. However due to the acute housing situation in the rual areas, the organization started its activities after its establishment with special emphasis on rural housing. Furthermore, rural housing is believed to be ultimately inexpensive since it could contribute positvely to reducing housing shortages in urban areas by helping to stem the rural to urban migration. He also emphasized the need to consider housing as an integral component of rural development programmes since it is important to provide other social amenities and services like water, schools, health centres, etc. to make any housing programme meaningful and successful. The importance of popular participation and the active support of state governments for the successful implementation of low cost rural housing programmes was also stressed.

62. The discussions also centred around the role that extension services play in promoting improved housing construction techniques developed by the research institutions. The National Buildings Organization undertakes the construction of demonstration houses in clusters of ten or twenty houses in selected parts of the country using improved local materials and locally available labour. Such programmes are supplemented with information dissemination through the mass media, films and permanent exhibitions in order to capture the interest of the public.

63. The general concensus of opinion at the end of the discussions was that African countries would have to continue to give increasing attention to housing needs in the rural areas, keeping in mind the need to utilize the materials locally available at different locations in the countries and to encourage research and development work that would help to improve the durability characteristics of such materials. Rural housing programmes should be planned and implemented within the framework of integrated rural development schemes if they are to contribute effectively to improving the living conditions of the rural folk. Governments would have to increase the resources available for rural housing schemes and should have suitable and effective mechanisms to ensure that these resources are used to achieve optimum results.

Urban housing (Session IX)

a) Presentation of paper

64. Mr. R.S. Gupta, member-engineer of the Delhi Development Authority (DDA) presented a paper entitled 'Urban Housing' which is summarized below:

65. The problem of Urban Housing is becoming more and more complex, because of the increased migration towards urban growth centres of people seeking better employment opportunities etc. In historical cities like Delhi, replacement of old houses which have become obsolete makes the problem more servere. The resources available for housing in most of the developing countries are not adequate. Added to this is the scarcity of essential building materials like cement, steel etc. felt in most of these countries.

66. Delhi Development Authority has tried to tackle the urban housing problem by taking some bold steps. It has acquired all available urban land. With a small seed capital, it took possession of part of this land, developed it, built some group housing and started disposing of these plots and houses. The capital has revolved many times over. 150,000 developed plots and an equal number of dwelling units have already been allotted or are likely to be allotted in the near future. All those desirous to have houses have to deposit registration money, which is utilized for building houses. These houses, on allotment, generate more funds for further house building programmes. The process thus continues in geometric proportion.

67. D.D.A. has also successfully completed a big resettlement programme by developing 27 colonies to house over 700,000 people. Finally, people themselves have put in lots of unauthorized housing in 612 colonies taking away almost 8,000 acres of land from planned development, which incidentally solved the shelter problem of over 1 million people.

b) Discussions

68. Mr. Gupta emphasized during the discussions that D.D.A. undertakes housing schemes for different income earners, with special attention being paid to the economically weaker sections of the urban population who are provided housing at heavily subsidized rates. Approximately 60 per cent of all dwelling units constructed by D.D.A. are allocated to people in this category.

69. In answer to questions on the Master Plan for Delhi, he said that a 20 year plan was formulated in 1962 and placed before the general public and then Parliament for approval, after which a legislative instrument giving it full legal status was passed. D.D.A. was also given the mandate to execute the plan. Besides this legal backing, the acquisition of land in the city has contributed significantly to a programmed development of Delhi. Co-ordination with various public utility organizations in the implementation of the plan is ensured through the D.D.A. machinery. These organizations participated in the preparation of the plan and their representation on the executive committee of D.D.A. and its technical committees ensures close collaboration among them.

70. The projects of D.D.A. are undertaken through qualified construction companies. D.D.A. does not find it economical to utilize direct labour for any of its projects.

71. The African experts felt that the apparent success of D.D.A. was due in part to the legal authority it had for the implementation of its schemes, as well as the clearly defined areas of responsibility which facilitated co-ordination of the activities of the different public agencies operating in the city of Delhi. The financial contributions by the government, though meagre compared to the tasks to be performed, have helped D.D.A. to make significant progress in its activities. Other major sources of finance have been commercial banks and life insurance corporations. In the light of the foregoing considerations it was concluded that the experience of D.D.A. should be of interest to African countries particularly in respect to the provision of housing in the urban areas. Effective methods for mobilization of funds and the provision of urban land for housing should be given priority attention.

Formulation and implementation of housing programmes and promotion of building industry (Session X)

a) Presentation of paper

72. The main paper entitled "Formulation and Implementation of Housing Programmes and Promoting of Building Industry was introduced by Dr. G.C. Mathur, Director of the National Buildings Organization (NBO). He stated that in India construction accounts for upto 50 per cent of expenditure on national development plans. In the wake of successive Five-Year Plans, the quantum of building and housing construction activities has increased considerably. Therefore, economy in the cost of construction and optimum utilization of all resources have become matters of great importance to the national economy.

73. A number of social housing schemes have also been taken up to ameliorate the housing conditions particularly of the economically weaker sections of the society. He gave brief details of these schemes and outlined problems encountered during their implementation. Dr. Mathur then mentioned the measures that had been taken for the development of the building industry to cope with the large-scale housing and building programmes, with particular reference to augmentation of building materials and discussed the role of the National Buildings Organization in this regard.

b) Discussions

74. During the discussions the African experts sought further clarification on the Indian experience in policy evolvement and the agencies involved in this exercise as regards formulation and implementation. Dr. Mathur described the organizational structure of the housing and construction industry with specific emphasis on the relationship between the Ministry of Works and Housing, the National Buildings Organization and Parliament. N.B.O. gives technical advice on housing policy to the Ministry of Works and Housing after consultations with all the agencies involved in the housing, building materials and construction industry. After getting approval of Parliament, the Ministry implements the policies. N.B.O., as a technical, promotional institution under the Ministry takes full responsibility for ensuring the successful implementation of policies on housing and construction.

75. Dr. Mathur further stated that even though at present India does not have a comprehensive housing policy document, work is in progress to publish such a document in the near future.

Technology transfer in building sector including documentation and dissemination of information (Session XII)

a) Presentation of paper

76. The paper on "Technology Transfer in Building and Housing including Building Information and Documentation" was presented by Dr. G.C. Mathur, Director of the National Buildings Organization. He noted that one of the important objectives of the National Buildings Organization is to achieve transfer of technology in building and housing with a view to ensuring reduction of cost and improvement in building and housing. Several schemes for effecting transfer of technology and results of research have been initiated by N.B.O. which include construction of experimental and demonstration building and housing projects both in urban and rural settlements, demonstration plants

for promoting the production of building materials, utilizing indigenous resources at economical cost, organizing permanent exhibition of building materials, techniques and designs of houses, etc., organizing building information and advisory services, conducting training and undertaking documentation activities. These activities and their impact have been described in the paper.

b) Discussions

77. The African experts acknowledged, during the discussions, that India had suceeded in overcoming the problem of technology complex and that this had contributed to the introduction of novel building materials and techniques into the building industry. The emphasis on developing and disseminating improved construction methods for rural areas was also very significant. The setting up of N.B.O. type organizations in African countries or the effective functioning of such institutions, where they already exist, was highly recommended.

78. As regards the question of adoption of Indian technologies in the building and housing sector, the experts agreed that there was much that African countries could learn from the Indian experience and that the study tour and workshop had provided opportunity to closely examine the technologies developed. Some of these could be adopted with some modification. It was also emphasized that there was need for establishing firm co-operation links between African countries and India, and in this connexion the important role of ECA and N.B.O. was stressed. India would be prepared to assist in training African personnel for the building industry both in India and in African countries themselves.

79. Another important subject for discussion was the position of an organization like N.B.O. within the government machinery. While recognizing that there were advantages and disadvantages with having such an institution either being directly under a ministry or being a fully autonomous institution, the experts agreed that it was important to ensure that, irrespective of its status, such an organization is able to function effectively so that it can fulfil the objectives for which it was set up.

IV RECOMMENDATIONS

The team of African building materials and construction industries experts:

- Having successfully concluded in India its eight weeks study of the policies, strategies, programmes, promotional methodologies, implementation mechanisms and institutional facilities and services adopted by India for the development of an indigenous self-reliant building materials and construction industries sector

- Having considered in this respect the practical results already achieved

- Recalling with concern that, despite adequate availability of the basic resources in the African region for the production and utilization of building materials, the demand for building materials and construction services is increasing higher and higher and most African countries are lagging behind in terms of the development of this sector and are consequently facing a critical shortage of building materials and construction services;

- Recognizing the imperative need for the speedy development of this sector in Africa in terms of optimum exploitation and utilization of locally available materials, new practical and locally relevant building materials and building techniques

- Appreciative of the actions being taken by the Economic Commission for Africa in consultation with and through African Governments for the implementation of a comprehensive programme for the development of this sector which has already yielded very satisfactory results and in particular its organizing a very useful study tour and workshop in India for the group of African experts

- Convinced that, within the framework of the mandate for and the implementation of the ECA development programme for this sector for the African region which is already in progress, the strategies and methodologies adopted by developing countries, in particular India, have a practical appeal for the African region on account of considerable similarity of developmental needs and conditions and provide a workable basis for their adoption in African countries with appropriate modifications and requirements to suit local priorities and conditions.

1. Recommends that:

In the field of policy, planning and promotion

(i) Each African government should speedily establish (or strengthen existing mechanism) a National Buildings Development Cell to assist governments in the detailed planning of this sector in respect of innovative policies and programmes and institutional services, including development of skills with the assitance of ECA wherever required, taking into account the relevance of India's experiences and availing of India's assistance, if necessary.

In the field of production of building materials

(ii) African governments should individually or through their economic communities, speedily undertake a detailed investigation, evaluation and documentation of locally available raw materials and promote schemes for developing/processing the raw materials for production of building materials, including the upgradation and optimum utilization of inferior grade material and secondary species of wood and their wastes.

(iii) African governments should draw up a long term development programme, with the assistance of ECA if necessary, for the establishment of production facilities for specific building materials based on concepts of small and medium scale production technologies, low investment, maximum use of local materials and wastes and local entrepreneurship, as well as relevant Indian experiences in the field of mini-cement plants, the production of lime, clay pozzolana, clay bricks and roofing materials, the use of secondary species of wood and utilization of non-conventional sources of energy (solar energy, biogaz, wind energy, etc.).

(iv) In order to popularize the production possibilities referred to above, ECA should assist African governments and their concerned economic communities in setting up pilot plants/demonstration projects in appropriate locations, as a matter of priority.

(v) Based on above efforts and experience, African governments must organize/ undertake required pre-feasibility/feasibility studies to lead to the establishment of a network of economically viable plants for production of building materials. ECA's assistance in this regard will be necessary.

In the field of low-cost housing

(vi) African countries should make concerted efforts to achieve low-cost housing, both in urban and rural areas, by improving the design and construction practices, efficent architectural planning, economical use of materials, new and improved construction techniques, better management of construction projects, etc. ECA should be instrumental in promoting developments in these fields.

(vii) To achieve significant results in the above fields, African governments should earmark specific funds for the implementation of low-cost housing projects.

(viii) To promote low-cost housing, experimental and demonstration housing projects should be undertaken in urban and rural areas, using innovative building techniques, new construction materials, new design concepts, etc. Proper feedback of experiences of such projects should be organized by ECA for effective transfer of technology in the field of low cost housing in the African countries.

In the field of research and material standardization

(ix) African governments should undertake a positive programme of promoting building and building materials research with emphasis on the development of appropriate technologies; for this purpose African governments should strengthen existing material laboratories or set up new research centres according to their needs with emphasis on regional and subregional co-operation as well as co-operation with countries outside the African region

(x) ECA should promote the establishment of regional/subregional research centres for the development of the building materials and construction industry in Africa and in this context, should assist selected existing national research centres to become focal points for urgent and specific research programmes.

(xi) The research programmes and the programmes for production of building materials should be effectively linked with national housing and construction programmes as well as with measures for the standardization of the building materials and their quality control.

(xii) To facilitate the development of new technologies and their effective application, ECA should promote and support the establishment of working groups/committees for the development, standardization and popularization of new technologies in Africa.

In the field of Information on building materials and building techniques

(xiii) ECA should establish a central information system (Data Bank) with subregional and national linkages, in order to give African countries access to technical information on the building and building materials industry in the African region and in countries outside the African region.

(xiv) ECA should assist African countries in respect of technical knowhow by organizing seminars, workshops and study tours for African experts on various aspects of the sector. The study tours should be organized in African countries themselves besides countries outside the African region. In this connexion, ECA is urged to organize a regional seminar as a follow-up to the current study tour and workshop in India.

In the field of skills development

(xv) African governments should organize specific programmes for manpower training with emphasis on skills upgrading and on-the-job training for artisans, craftsmen and technicians.

In the field of International Co-operation

(xvi) ECA should establish operational linkages with various organizations within and outside the African region with a view to assisting African countries in developing bilaterial and multilateral technical co-operation in the field of building materials and construction industries.

2. Expresses its deep gratitude to the Government of India for its gesture of co-operation and practical assistance which has enabled the group of African Experts to study in detail India's experiences and institutions in the building and building materials industry.

3. Further expresses its deep gratitude to ECA and U.N.D.P. for organizing this study tour and workshop.

4. Requests in the context of the above mentioned recommendations:

(xvii) The ECA to take further steps to render technical and field assistance to African governments for the implementation of specific projects as may be identified by them.

(xviii) The Government of India to continue its interest in the development of the building and building materials industry in the African region and to extend to African countries technical, financial and other assistance in the practical implementation of projects identified in the study tour and workshop, as may be requested by them either directly or through the ECA.

V. VOTE OF THANKS

Considering the success of the eight week study tour and workshop in India organized by the United Nations Economic Commission for Africa in collaboration with Indian organizations and experts,

Appreciating the significant financial and technical assistance provided by the Government of India in this regard,

Grateful for the warm hospitality accorded to the team of experts throughout the period of their stay in India and the excellent arrangements made for the study tour and workshop, and

Noting the dynamic implementation of the ECA programme for the development of the building materials and construction industries in the African region which culminated in the study tour and workshop,

We, the African experts on building materials and construction industries who have completed a study tour in India and participated in this technical workshop,

(i) Sincerely thank the Government of India, specially the Ministry of Commerce, the Ministry of Works and Housing and the Ministry of External Affairs for making our visit to India possible and fruitful;

(ii) Express our gratitude to the National Buildings Organization (N.B.O.), the Cement Research Institute of India (C.R.I.), the Central Building Research Institute at Roorkee (C.B.R.I.), the Structural Engineering Research Centre at Roorkee and Madras (S.E.R.C.), the Forest Research Institute at Dehradun (F.R.I.), the Indian Plywood Industries Research Institute at Bangalore (I.P.I.R.I.), the Delhi Development Authority (D.D.A.), the Housing and Urban Development Corporation (H.U.D.C.O.), the State Housing Boards of Tamil Nadu and Karnataka, the Brick and Tile Manufacturers Federation, the Lime Manufacturers Association and all other organizations and individuals who have in diverse ways contributed to the success of our visit to India,

(iii) Congratulate the United Nations Economics Commission for Africa for the positive steps it is taking to ensure the rapid and rational development of the building materials and construction industries in the African region and urge it to maintain the tempo of its development programme until the African region becomes self-sufficient in this sector.